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GB 0913211
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(71) Applicant
Cummins Engine
Company Inc
(USA–Indiana)
1000 Fifth Street
Columbus
State of Indiana 47201
United States of
America
(72) Inventors
Pierre Bernard French
David Leigh Antcliffe
Gerald Lowe Donnellan
(74) Agent and/or Address for
Service
W P Thompson & Co
Coopers Building
Church Street
Liverpool L1 3AB

(54) Exhaust braking valve

(57) An exhaust braking valve, for use with an internal combustion engine having a divided exhaust manifold and a turbocharger having a turbine wheel to which two separate gas flows can be led from said divided manifold, is constructed such that, in a non exhaust braking condition, free but separate flow of the two gas paths from the divided manifold to the turbine wheel is provided but, in an exhaust braking condition, gas flow to the turbine wheel is cut off by a closure member (19) of the valve and an interconnection between the two gas paths is provided at a location upstream of the closure member (19). The interconnection of the upstream portions of the flow paths, viz 14*a*, 14*b*, may be effected by means of recesses 28, 30 provided in the valve rotor 20 and/or in the valve housing. In the modificaion the valve closure is a sliding gate.

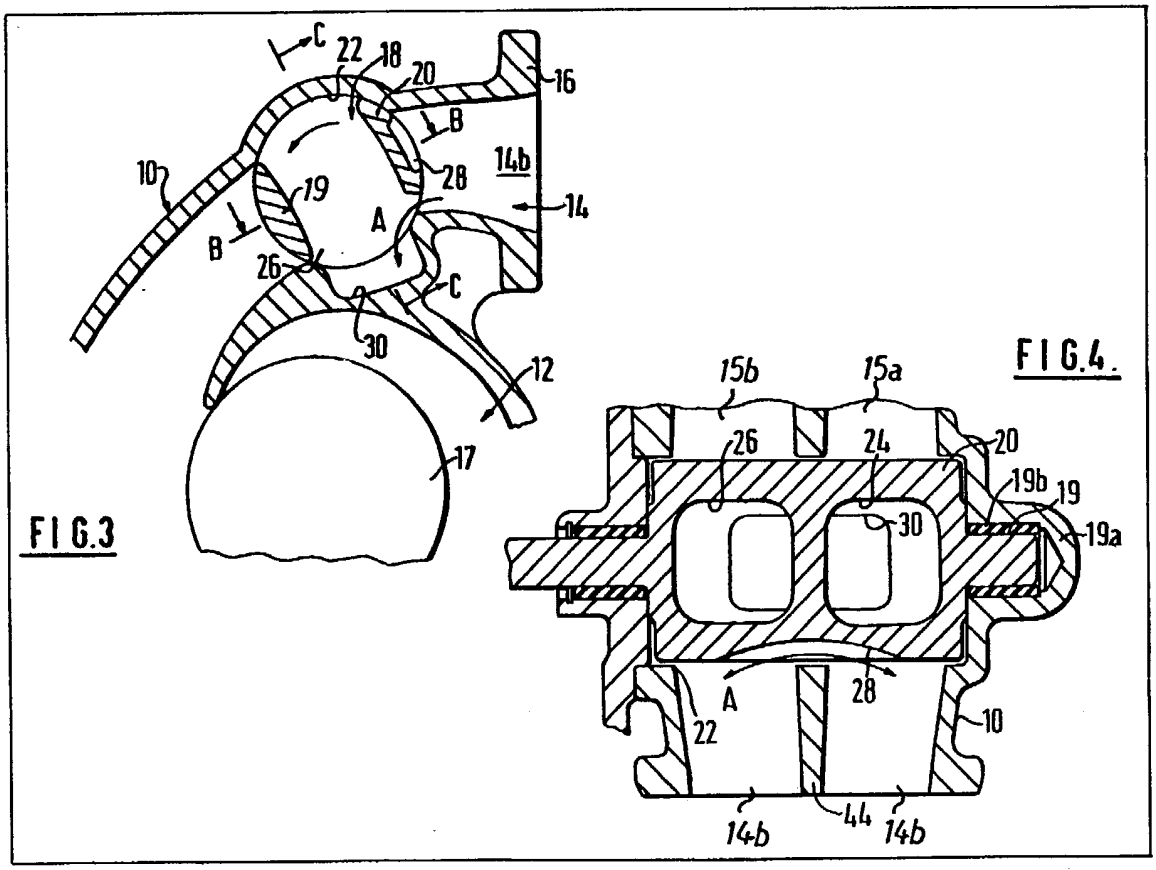

FIG.3

FIG.4.

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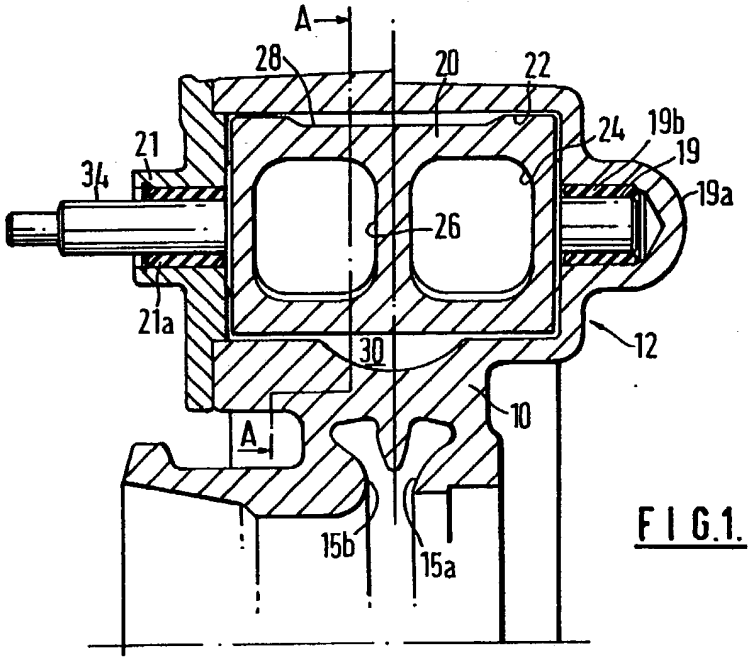
A
28
20
22
24
19b
19
19a
21
34
26
21a
30
12
10
A
15b
15a

FIG.1.

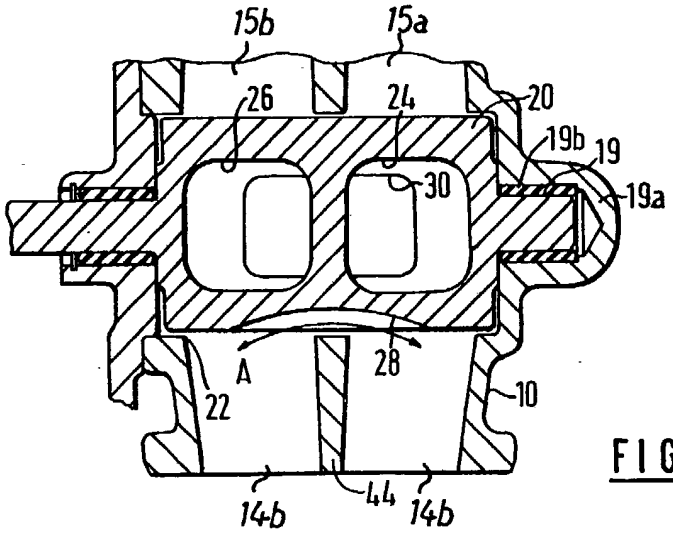
15b
15a
26
24
20
19b
19
19a
30
A
28
22
10
14b
44
14b

FIG.4.

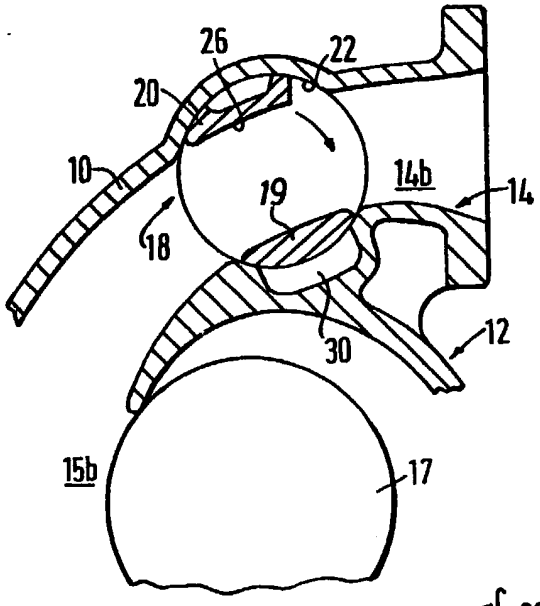
26
22
20
10
19
14b
14
18
30
12
15b
17

FIG.2

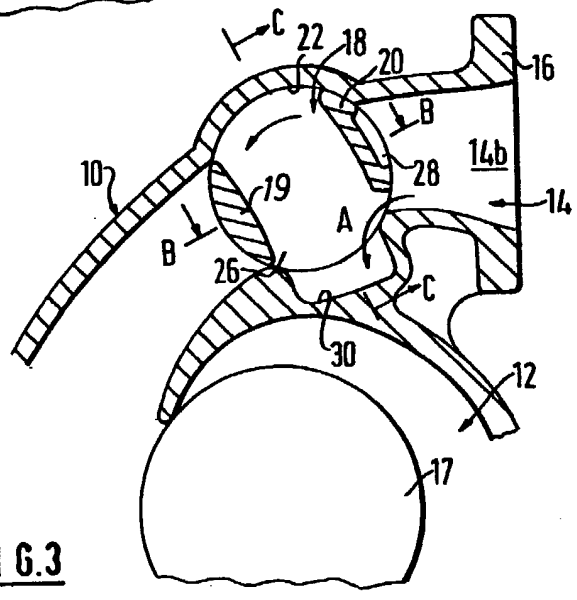
C
22
18
20
16
B
14b
10
19
28
14
A
B
26
C
30
12
17

FIG.3

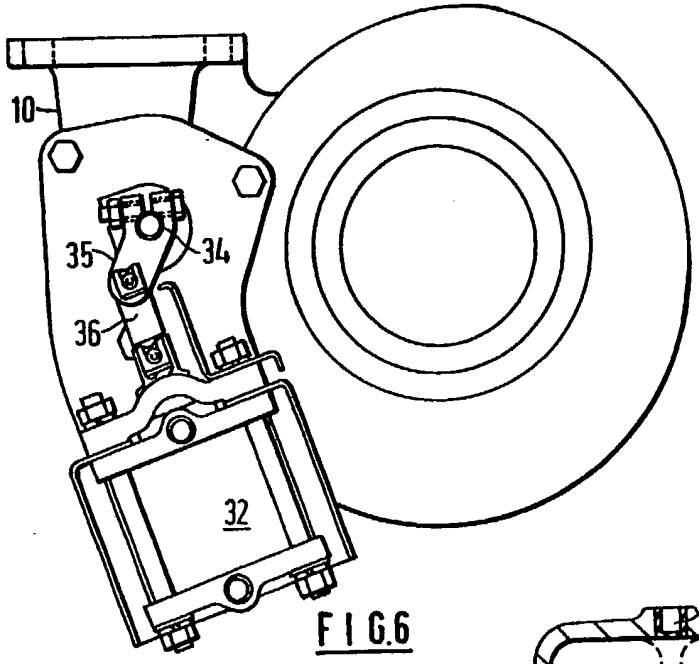

FIG.6

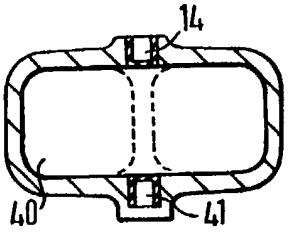

FIG.8

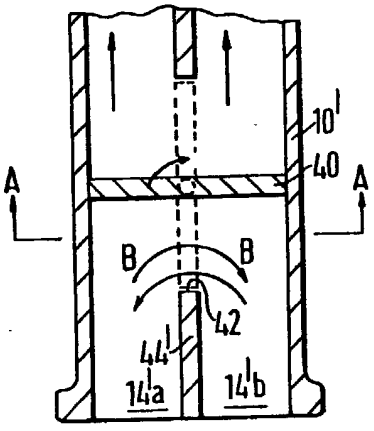

FIG.7

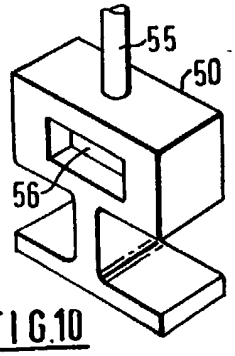

FIG.10

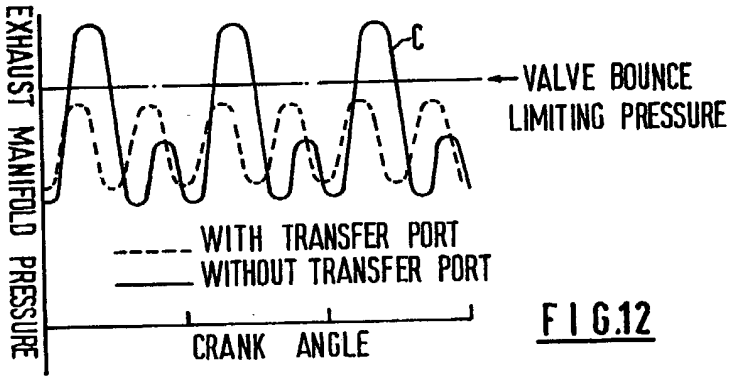

FIG.12

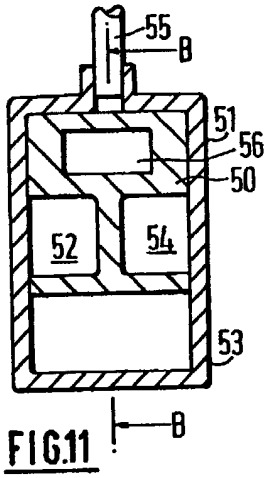

FIG.11

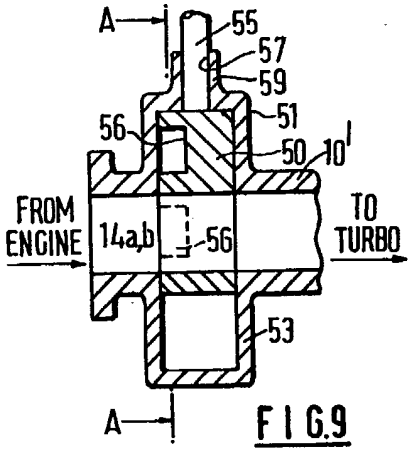

FIG.9

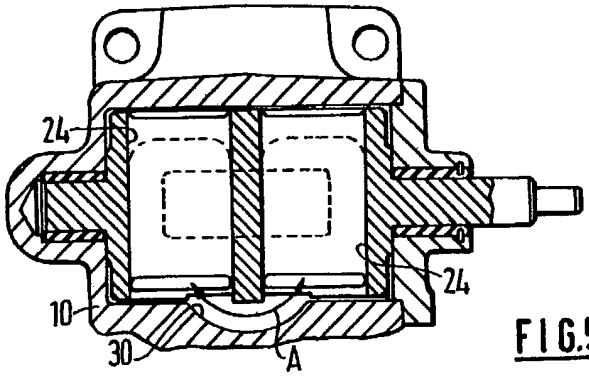

FIG.5

SPECIFICATION

Exhaust braking valve

The present invention is concerned with exhaust braking valves for internal combustion engines fitted with turbochargers.

Various types of exhaust braking valves have been provided on internal combustion engines equipped with a turbocharger, to provide a means for retarding the vehicle to which the engine is fitted. It does so by at least substantially blocking the engine exhaust pipe during motoring so that the energy required to compress the air against the obstruction is translated back through the vehicle drive train to retard it. An example is that described in U.S. Patent No. 4 138 849 to which reference is directed.

One shortcoming of such devices when fitted to engines having a divided exhaust manifold and a turbocharger having a twin entry turbine housing (in which each half of the divided manifold is connected to a respective turbine housing entry) is that closure of the exhaust braking valve effectively separates the two halves of the divided manifold into two small volume gas receivers. This results in a high peak exhaust manifold pressure when one cylinder exhausts into the manifold causing adjacent exhaust valves to be unseated against the normal valve spring closing force. This permits high pressure gas to be admitted through the unseated exhaust valve into a cylinder when the piston is near to the bottom of its induction stroke. The effect of this is to cause the engine to further compress the hot, high pressure gas thus admitted to the cylinder, resulting in high cylinder pressures and temperatures.

To overcome this problem it has been common practice to reduce the peak exhaust pressure in the exhaust manifold by providing gas pressure limiting means, usually by providing a leakage path for exhaust gas past the valve closure member. However, this effectively reduces the mean exhaust pressure in the manifold and hence the effectiveness of the device as a vehicle retarding means.

It is an object of the present invention to provide an exhaust braking valve which overcomes the aforementioned shortcomings.

In accordance with a first aspect of the present invention there is provided an exhaust braking valve for use with an internal combustion engine having a divided exhaust manifold and a turbocharger having a turbine wheel to which two separate gas flows can be led from said divided manifold, said valve being constructed such that, in a non exhaust braking condition, free but separate flow of the two gas paths from the divided manifold to the turbine wheel is provided but, in an exhaust braking condition, gas flow to the turbine wheel is cut off by a closure member of the valve and an interconnection between the two gas paths is provided at a location upstream of the closure member.

In accordance with a second aspect of the present invention there is provided an exhaust braking valve of the above type, wherein said valve comprises a hollow section having two inlet passages for communicating with the two halves of the divided exhaust manifold and two outlet passages for communication with the two inlet passages of the turbine housing, an adjustable member mounted within the hollow section for selective adjustment between an exhaust braking position which substantially prevents the flow of gas from the inlet to the outlet passages of the hollow section and a non-exhaust braking position which permits free flow of gas between the inlet and outlet passages of the hollow section, and at least one further passage arranged to connect said two inlet passages to each other, said further passage being unobstructed and open to permit the flow of gas between the two inlet passages when the adjustable member is in the exhaust braking position and closed to prevent the flow of gas between the two inlet passages when the adjustable member is in the non-exhaust braking position.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is a sectional plan view of one embodiment of an exhaust braking valve in accordance with the present invention;

Figure 2 is a section on A–A in Fig. 1 with the valve open and the interconnection passages closed;

Figure 3 is a section on A–A in Fig. 1 with the valve closed and the interconnection passages open;

Figure 4 is a section of B–B in Fig. 3;

Figure 5 is a section on C–C in Fig. 3;

Figure 6 is an external plan view showing one actuating mechanism for the valve;

Figure 7 is a diagrammatic sectional view of a second embodiment in accordance with the invention having a butterfly valve.

Figure 8 is a section on A–A of Fig. 7;

Figure 9 is a sectional view of a third embodiment in accordance with the invention;

Figure 10 is a perspective view of a valve element of the embodiment of Fig. 9;

Figure 11 is a section on A–A in Fig. 9; and

Figure 12 is a graph of exhaust manifold pressure plotted against crank angle which demonstrates the advantages of the invention.

As best seen in Figs. 1, 2 and 3, the first embodiment is incorporated in the housing 10 of a twin entry turbocharger 12. The housing 10 has an inlet 14 fitted with a flange 16 by which the housing can be attached to the discharge side of a divided exhaust manifold of an engine (not shown). The inlet 14 com-

prises a pair of parallel inlet passageways 14a, 14b constituting the twin entry pipes to a twin entry turbocharger whereby each half of the divided manifold is connected to a respective turbine housing entry 15a and 15b for discharge across an appropriately journalled turbine wheel 17.

The passageways 14a, 14b can be selectively closed by means of a valve arrangement 18 for the purpose of obtaining engine braking. In this particular embodiment, the valve is of the rotary cylinder type having a rotor 20 journalled in a cylindrical chamber 22 by means of integral shafts 34 and 19. Shaft 19 is journalled within a boss 19a on housing 10 by a bearing 19b. Shaft 34 extends through a boss 21 to the exterior of housing 10 and is journalled by bearing 21a. The rotor 20 contains a pair of transversely directed through-passages 24, 26 which in the open state of the valve, as best seen in Fig. 2, form continuations of the passageways 14a, 14b to thereby permit free and unrestricted flow of exhaust gas from the divided manifold to the turbine wheel 17. In passing between the manifold and the turbine wheel 17, the gases in the passageways 14a, 14b are kept entirely separate in this condition of the valve 18.

However, when the valve 18 is rotated approximately 90° to its closed condition, blocking flow to turbine housing entries 15a, 15b by means of its section 19 as shown in Figs. 3, 4 and 5, the passage sections 14a, 14b upstream of the valve closure member are interconnected. The cross-sectional area of the interconnection between the passage sections 14a and 14b is dimensioned such that any restriction to the flow of gas through the interconnection does not cause the pressure pulses in either half of the divided manifold to rise above a predetermined maximum.

The desired cross-sectional area for the interconnection may be achieved by providing a single passage formed either within the valve housing or within the valve closure member or by means of a plurality of passages formed either within the valve housing or within the valve closure member. The desired cross-sectional area for the interconnection may also be achieved by providing a passage or passages in both the valve housing and in the valve closure member.

As illustrated in Fig. 4, one interconnection is through a recess 28 in the rotor 20 that extends laterally with respect to the gas flow into passages 14a and 14b and across the wall 44 which divides these passages. The other interconnection is by means of a similarly directed recess 30 in that part of the housing 10 forming the cylindrical side wall of the chamber 22. As best seen in Figs. 3 and 5, the recess 30 interconnects the passages 14a, 14b by way of the rotor bores 24, 26, which, in the condition shown in Figs. 3 and 5, are arranged to remain in partial communication with the respective passage portions 14a, 14b. This path is indicated by the arrow A in Fig. 3.

Thus, by this means, a flow of gas between the two passages 14a, 14b is permitted when the valve is in its closed condition in which it cuts off the gas flow to the turbine.

One possible mechanism for controlling the actuation of the valve is shown in Fig. 6 and uses an externally mounted actuator cylinder or solenoid 32 to rotate the shaft 34 of the rotor 18 through approximately 90° by way of a linkage 36 and crank arm 35 clamped to shaft 34 in a manner similar to that described in the aforementioned U.S. Patent No. 4 183 849.

Figs. 7 and 8 show another embodiment wherein the rotor of Figs. 1 to 5 is replaced by a butterfly valve 40 mounted on spindles 41 which are journalled in housing 10 so that the valve 40 pivots about an axis contained substantially within the plane of dividing wall 44'. The valve 10 in its open condition (illustrated by dashed lines in Fig. 7) is arranged to fully occupy an aperture 42 in the wall 44' which separates the passageways 14a, 14b but which, in the closed condition of the valve shown in solid lines, leaves an open connection via one half of the aperture 42 which allows the passages 14a, 14b to freely communicate, as indicated by the arrows B in Fig. 7. An actuator mechanism is connected to one of the spindles 41 to pivot valve 40 between its positions.

Figs. 9 and 10 show a further alternative where the rotary valve of Figs. 1 to 5 is replaced by a linear guillotine valve. The latter arrangement uses a sliding gate member 50 adapted to slide in a direction transversely of the passageways 14a'', 14b'' in chambers 51 and 53 which are integral with and integral with and extend outward from housing 10''. A shaft 55 extends through an opening 57 in boss 59 extending from chamber 51. In the open condition of the valve, the gate member provides a pair of passages 52, 54 which allow free flow of gas along the passageways 14a'', 14b'' to the turbine. However, in the closed condition of the valve, a recess 56 in the gate member 50 allows communication between the passages 14a'', 14b'' whilst cutting off all gas flow to the turbine wheel.

All of the embodiments described above provide a dramatic reduction in the peak pressures experienced in the exhaust manifold. To illustrate this phenomenon, the curve of Fig. 11 shows exhaust manifold pressure plotted against crank angle resulting from three cylinders of a six cylinder engine exhausting into one half of a divided manifold. The curve C with the higher peaks and smaller intermediate peaks is that which results when an exhaust braking valve is used that effectively separates the exhaust manifold into two dis-

crete sections. The curve D with approximately equal peaks is that which results when an exhaust braking valve is used which provided a connection between the two halves of the manifold as proposed herein. This effectively doubles the volume into which each cylinder exhausts and hence produces lower peak pressures. Similar conditions exist within each half of a divided exhaust manifold for any multi-cylinder engine.

The effect of this is to reduce the peak pressure to a value below that which is capable of unseating exhaust valves and at the same time to increase the mean value of the exhaust manifold pressure. This means that each cylinder is exhausting against a higher manifold pressure which effectively increases the braking effect of the engine on the vehicle. At the same time, cylinder temperatures are reduced compared with the condition where no interconnection is provided.

CLAIMS

1. An exhaust braking valve for use with an internal combustion engine having a divided exhaust manifold and a turbocharger having a turbine wheel to which two separate gas flows can be led from said divided manifold, said valve being constructed such that, in a non exhaust braking condition, free but separate flow of the two gas paths from the divided manifold to the turbine wheel is provided but, in an exhaust braking condition, gas flow to the turbine wheel is cut off by a closure member of the valve and an interconnection between the two gas paths is provided at a location upstream of the closure member.

2. An exhaust braking valve for use with an internal combustion engine having a divided exhaust manifold and a turbocharger having a turbine wheel to which separate gas flows can be led from the divided manifold, wherein said valve comprises a hollow section having two inlet passages for communicating with the two halves of the divided exhaust manifold and two outlet passages for communication with the two inlet passages of the turbine housing, an adjustable member mounted within the hollow section for selective adjustment between an exhaust braking position which substantially prevents the flow of gas from the inlet to the outlet passages of the hollow section and a non-exhaust braking position which permits free flow of gas between the inlet and outlet passages of the hollow section, and at least one further passage arranged to connect said two inlet passages to each other, said further passage being unobstructed and open to permit the flow of gas between the two inlet passages when the adjustable member is in the exhaust braking position and closed to prevent the flow of gas between the two inlet passages when the adjustable member is in the non-exhaust braking position.

3. An exhaust braking valve as claimed in claim 2, wherein the valve is of rotary cylindrical configuration and includes a rotor which constitutes said adjustable member and is journalled in said hollow section of the valve, the rotor having a pair of transversely directed through passages which, in the open condition of the valve, permit said free flow of gas between said inlet and outlet passages.

4. An exhaust braking valve as claimed in claim 3, wherein, in the closed position of the valve, said inlet passages are interconnected by way of one or more passages in the wall of said hollow section.

5. An exhaust braking valve as claimed in claim 3, wherein, in the closed position of the valve, said inlet passages are interconnected by way of one or more passages formed within said rotor.

6. An exhaust braking valve as claimed in claim 3, wherein, in the closed position of the valve, said inlet passages are interconnected by way of one or more passages formed within said rotor and by way of one or more passages formed in the wall of said hollow section.

7. An exhaust braking valve as claimed in claim 5 or 6 in which the rotor contains a peripheral recess which, in combination with an end edge of a central wall disposed between said two inlet passages, forms said passage in the rotor by which the inlet passages are interconnected in the closed position of the valve.

8. An exhaust braking valve as claimed in any of claims 3 to 7, including an externally mounted actuator for selectively rotating the rotor between its closed and open position.

9. An exhaust braking valve as claimed in claim 2 wherein the valve is of butterfly configuration and includes a pivotable flap member which constitutes said adjustable member and is journalled in said hollow section of the valve, the pivoting axis of said flap member lying in the plane of a wall disposed between said inlet passages whereby, in the open condition of the valve, the flap member fully occupies an aperture in said wall but, in the closed position of the valve, the flap member closes off said outlet passages and permits interconnection of the inlet passages via the upstream half of said aperture.

10. An exhaust braking valve as claimed in claim 2 wherein the valve includes a sliding gate member which constitutes said adjustable member and is mounted for linear displacement in a direction generally transversely of said inlet and outlet passages, the gate member including a pair of through passages which, in the open condition of the valve, respectively interconnect the inlet passages with the outlet passages, and a recess which, in the closed condition of the valve, interconnects said inlet passages.

11. An exhaust braking valve substantially

as hereinbefore described with reference to and as illustrated in Figs. 1 to 5, or in Figs. 7 and 8, or in Figs. 9, 10 and 11 of the accompanying drawings.

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